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On the Reproductive Behavior of the Sponge Blenny, *Paraclinus marmoratus* (Steindachner).

CHARLES M. BREDER, JR.

New York Aquarium

(Plates I-III; Text-figure 1).

INTRODUCTION.

Studies on the life history and development of the sponge blenny, *Paraclinus marmoratus* (Steindachner), Breder (1939), have been followed in March, 1941, by studies on reproductive behavior. The material was obtained from the same locality, Pelican Bay, and the work carried on at the research station of the New York Aquarium, located at Palmetto Key, Florida. Again, Mr. M. B. Bishop of the Peabody Museum, Yale University, was of aid in the collecting activities.

LOCATION OF NESTS.

During the winter of 1939-1940 a heavy freeze in this area, coupled with the presence of a large amount of cold water, caused a heavy mortality in the local fish population. It evidently changed the nature of the bottom invertebrate fauna to a considerable extent and *Paraclinus* was not as numerous as the year preceding the freeze. The observations were made a month later than those on which the first paper was based. Nevertheless, due to annual variations, the mean water temperature for March was lower, 67° as against 70° for February, 1939. It was first thought that the height of the spawning season had passed, although this was subsequently found to be untrue. Actually, most of the local population of *Paraclinus* was to be found along the northwest shore of Palmetto Key in beds of eel grass and in a ripe or nearly ripe state. It may be that they were just moving into Pelican Bay because of a thermal delay or that they had changed their center of abundance to some extent. In any event, nests were found only in Pelican Bay and were only two in number. One was built in a bed of filamentous algae, a new site for such nests, and the other in a cavity at the base of a sponge, *Verongia fistularis* (Pallas), of the type with which these fish are often associated. In this case the male was obtained with the nest of eggs. All were transferred intact to an aquarium. The

observations of behavior are based on the activity of this fish and three females placed in the same aquarium.

PARENTAL CARE.

As soon as the nest under discussion was placed in an aquarium, the male took up a position immediately under the eggs, as shown in Pl. I, Fig. 1. Almost at once he started working over the eggs. Every so often he would take a small part of the cluster in his mouth and pull on it. He was first thought to be eating the eggs, but it was soon seen to be some sort of fluffing process which loosened the entire mass. Alternating with this process the male would nestle under the eggs and violently agitate the cluster with one pectoral fin, then slightly rolling over would agitate the mass from the other side with the other pectoral fin, and occasionally would use both at once. This action was very violent, the fish bracing itself solidly with its ventral fins and the expanded tail during these movements. The action is as violent on the stringy mass of eggs as that undertaken by an *Ameiurus* on its eggs. Apparently vigorous agitation is necessary for the development of such agglutinated eggs. At least, it is difficult to hatch either in standing water.

The attending fish was extremely busy, twisting, turning and occasionally coiling itself around the eggs and poking at them with its mouth from all possible angles.

At times the fish would back out of the nest and take hold of the edge of the egg mass and pull it out while energetically shaking it. This is shown in Pl. I, Fig. 2. All these acts seem to insure aeration to the most centrally located eggs. Less frequently it would back well out of the nest area and pull on the egg mass until the entangling fibers were drawn out into long threads as shown in Pl. II, Fig. 3. When the eggs were released these fibers would spring back and return the attached eggs to approximately their former positions.

This type of activity continued for the duration of the observations.

SPAWNING.

On this same day, March 13, three females were added to the aquarium. As soon as they became composed they began to explore their surroundings. The largest, with her abdomen bulging, approached the nest and its guarding male. Although the male was quite dark, mostly brownish, on sighting the approaching female he put on an intense purple coloration which was nearly black and dotted with brilliant metallic blue. Contrasted to this, the female was very light, almost white, with tan markings. After some hesitancy and a few false starts, she entered the nest without much ceremony while the male vibrated his body briskly. He came half out of the nest hole and she, twisting to an inverted position, slipped in beside him as shown in Pl. II, Fig. 4. In this figure her body is mostly hidden by his but the tail and after part may be seen in the lower left hand corner.

A moment later she had slipped further into the nest and he backed in with her, the female retaining her inverted position while the male remained upright. The light but characteristic markings of the female are well shown in Pl. III, Fig. 5, which is a photograph of the actual spawning operation. A single egg, attached by its thread, which had become displaced, may be seen just above the female's anal fin and below the tip of the male's jaw. At such times the bodies of both fish would vibrate violently. The pair seemed to have spawned several times before the female withdrew from the nest in a much deflated condition. Due to the confined quarters of the small nest hole, further details of the spawning were not discernible. In any event, it is certain that a close approximation of the genital pores is not necessary in these fish. No genital papilla could be detected. The opinion expressed by Breder (1939) in regard to males spawning with a succession of females was confirmed upon further examination of the nest. This examination showed the well developed eggs in various stages with which the male was originally found, together with new eggs, fertilized in the aquarium.

This same female, about an hour later, entered the nest again and the spawning act was repeated with identical detail. While this was going on, a second female approached the nest. After the

first female had left the nest, the second, which was very similar to the first in coloration but slightly smaller and not quite so heavy, attempted to enter. However, instead of being greeted by a vibrating male, she was greeted with an open mouth and a threatening attitude. On this rebuff she backed off. On a second attempt she was more insistent and disregarded his threatening attitude. This resulted in the male's biting at her and she then gave up any further attempts.

Since the male took his threatening attitude when only her head was visible to him, it is thought that he was at least temporarily exhausted and resented the approach of any other fish bent on spawning or egg stealing. The threatening attitude and the approach of the second female is shown in Pl. III, Fig. 6.

These observations were made in the late afternoon and by dusk he had lost his deep purple and had taken on a lighter color, especially on the sides of the body.

There were no further attempts at spawning, but the male continued to tend the eggs, with some interruption, until decomposition of the sponge, which had died, forced a conclusion to the observations.

DEVELOPMENTAL NOTES.

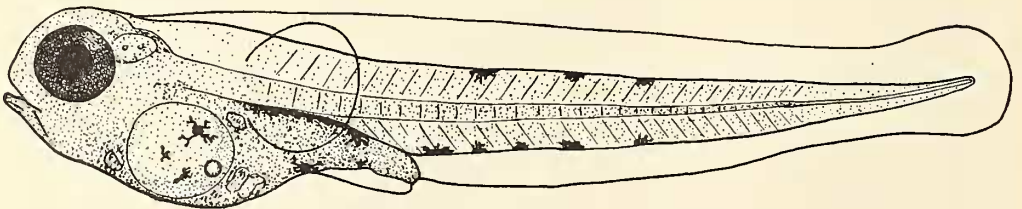
The eggs from the nest in filamentous algae were incubated with some difficulty. The larvae, however, were carried on to a stage a little beyond those mentioned in the earlier paper. It was noted that the oil globule in the yolk shrank rapidly and before a day of life after hatching the larvae sought the bottom of their dish and were negatively phototropic. It would seem from this that their life as planktonic elements must be exceedingly short and may in fact never be fully realized in a state of nature.

Text-fig. 1 shows a lateral view of such a larva, March 14, less than 24 hours from the hour of hatching. A sudden drop in temperature carried the water in the laboratory to 60° F. followed by death of all eggs and larvae.

DISCUSSION.

The literature on the reproductive habits of the blennies is scant but evidently *Paraclinus* is fairly typical in its reproductive behavior.

The spawning of *Clinus argentatus* Cuvier &



Text-figure 1.

Larva less than 24 hours old. At this time they seek the bottom and are negatively phototropic. See Breder (1939) for earlier stages and eggs.

Valenciennes is described by Guitel (1892 and 1893a) as taking place with the female in an inverted position. Apparently the original nest site is selected by the female, an item of behavior the present observations did not cover, but as in *Paraclinus* the guarding males will receive the product of several females. Although Guitel's description differs in detail, the general performance must be very similar. It would seem likely that the differences noted are merely incidental, and due chiefly to those associated with environmental differences, number of fishes present, et cetera. The described color changes, so far as they go, must also be closely similar.

Blennius montagui Fleming spawns with both fish in an inverted position according to Guitel (1893a and b). It would seem probable that whether only the female or both fish turn over may be incidental and subject to considerable individual variation. *Blennius sphynx* Cuvier & Valenciennes, according to the same author, behaves in an essentially similar manner.

Heterostichus rostratus Girard has thread-bearing eggs but according to Barnhart (1932) the habits must be rather different from the preceding forms.

The above four species all have eggs provided with adhesive filaments. Among those forms with eggs that are merely adhesive, the data in the literature is not sufficiently detailed to warrant a close comparison.

Of the various types of fishes which produce eggs with adhesive filaments, generally attached to the underside of some object, the present case seems to be the first notice of a fluffing process employed by the attendant male. The nature of the fibrous tangle in which the eggs are found makes such a process possible. In such forms as *Monocirrhus polyacanthus* in which each egg hangs separately by a single thread, no such behavior was noted by Coates (1933). In others, such as some of the Exocoetidae, Belonidae, Cyprinodontidae and Atherinidae, there is no parental care accompanying the production of thread-bearing eggs.

SUMMARY.

1. The male *Paraclinus marmoratus* guards and tends its eggs, a prominent feature of the care being that at intervals the tangled clump of thread-bearing eggs is pulled open and fluffed.
2. Wandering females are received by the male, adding their eggs to those already present and spawning in an inverted position while the male remains upright.
3. The nesting male on exhaustion will repulse additional females with the typical warning attitude or eventual biting.
4. The larvae, which float on hatching, seek the bottom within a day and are thus a planktonic element for only a very brief time.

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EXPLANATION OF THE PLATES.

PLATE I.

- Fig. 1. Male *Paraclinus marmoratus* standing guard under its eggs in a basal cavity of a sponge. *Verongia fistularis*. This photograph and those following are all of one male, showing various activities incident to reproduction.
- Fig. 2. The male tugging at the thread-bearing egg mass. This activity apparently insures aeration of the entire cluster.

PLATE II.

- Fig. 3. Sometimes long strands would be pulled far out, as here shown. A moment after this photograph was taken the fish relinquished its hold and the resilient threads snapped back into place.

- Fig. 4. A female entering the nest. She is in an inverted position, her tail showing in the lower left hand corner, while the male, who has half left the nest with fins wide spread, hides her anterior parts.

PLATE III.

- Fig. 5. The actual spawning process. Note that the female is in a very light color phase and the male very dark. A single dislodged egg may be seen above the anal fin of the female and below the tip of the male's jaw.
- Fig. 6. Another female approaches immediately after the preceding spawning and is greeted by the typical threatening attitude.